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Motor Shaft Assembly and Method

Technical Field

5 The present invention relates generally to  
motors, and more particularly to a method of assembling a  
motor and associated components such that the motor is  
capable of driving an apparatus located a significant  
distance from the motor.

Background Art

10 In motor assembly situations, it is typically  
necessary to assemble a motor shaft within a motor  
housing. Additionally, it is often necessary to affix a  
component to the motor shaft after the motor shaft and  
the motor housing are assembled. In many applications,  
it is also necessary for a motor to drive an apparatus  
15 located a significant distance from the motor.

One method of assembling a motor shaft in a  
motor housing includes the step of installing a snap ring  
into a groove in the motor shaft. The snap ring serves  
as a retainer for a bearing that is pressed onto the  
20 motor shaft. The motor shaft and associated components  
are installed into the motor housing with one end of the  
shaft protruding from the housing. A barrel spacer is  
then fitted onto the shaft next to the bearing and  
protrudes from the motor housing. A first washer is slid  
25 onto the protruding end of the shaft and abuts the barrel

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spacer. In certain applications a component, such as an  
impeller, may also be slid onto the protruding end of the  
shaft into abutment with the first washer. A second  
washer is placed onto the motor shaft to sandwich the  
5 component between two washers. A hex nut is then  
threaded onto the end of the protruding shaft to hold all  
components on the shaft together in an axial direction  
against the snap ring. The threaded nut serves to apply  
pressure to the washers, which in turn hold the impeller  
10 to insure that the impeller rotates as the motor shaft  
rotates.

For applications where the motor is used to  
drive an apparatus located a significant distance from  
the motor, a shaft extension is typically threaded onto  
15 the end of the motor shaft. The shaft extension is  
coupled to the apparatus in any suitable manner.

The previously described method has  
disadvantages. When a motor having a long shaft is  
operated, torsional forces create shaft whip and wobble  
20 that create noise and vibration during motor operation,  
this problem is compounded when a threaded shaft  
extension is used. The installation of the threaded  
shaft extension onto the motor shaft often results in  
misalignment between the shaft extension and the motor  
25 shaft.

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Summary of the Invention

5 The present invention is embodied in a method of assembling a motor shaft with a motor component assembly. The method includes the steps of upsetting a portion of the motor shaft, inserting the motor component assembly, comprising a keyed spacer and a motor component onto the shaft, and pressing an extension onto the shaft into abutment with the motor component assembly.

10 The motor component assembly further includes a keyed washer disposed between the motor component and the extension.

The extension includes a tube that extends past the end of the motor shaft when a first end of the tube is in abutment with the motor component assembly.

15 The method of the present invention further includes the step of pressing a shaft extension into a second end of the tube.

20 In accordance with the present invention, the extension includes a metal shaft having a first bore to accommodate the motor shaft and a second bore.

The motor component includes an impeller.

25 According to another aspect of the present invention, a method of assembling a motor shaft with a motor component is disclosed. The method includes the steps of fitting a first end of a shaft extension into an end of the motor shaft, tightening a retainer onto the

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motor shaft, and installing a second end of the shaft extension into a lower assembly.

Other features and advantages of the present invention will become apparent from the attached specification and drawings.

Brief Description of the Drawings

FIG. 1 comprises a fragmentary elevational view, partly in section, of a motor assembly assembled in accordance with one embodiment of the present invention;

FIG. 2 comprises an exploded perspective view of the motor assembly of FIG. 1;

FIG. 3 comprises a fragmentary elevational view, partly in section, of a motor assembly comprising a tube coupling an extension onto the motor shaft;

FIG. 4 comprises a fragmentary elevational view, partly in section, of an alternate embodiment of a motor assembly comprising a retaining nut and a hexagonal shaft extension;

FIG. 5 comprises a fragmentary elevational view, partly in section, of an alternate embodiment of a motor assembly comprising retaining nut and a flexible shaft;

FIG. 6 comprises a fragmentary elevational view, partly in section, of an alternate embodiment of a motor assembly comprising a retaining nut attached to a flexible shaft extension.

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Description of the Preferred Embodiments

Referring now to FIGS. 1 and 2, a motor assembly 10 constructed using the method of the present invention is shown. The motor assembly 10 comprises a motor shaft 15, a bearing 20 and a spacer 25 disposed between first and second upset portions 30, 35, a drive washer 40, an impeller 45, a second washer 50, a motor shaft extension 55, and a motor housing 60. It should be noted that the impeller 45 may be replaced by any other suitable component. The motor assembly further comprises a second impeller 62 disposed within a housing 64. Alternatively, the second impeller 64 may be replaced with any suitable component.

After the first upset portion 30 is formed on the shaft 15, the bearing assembly 20 and the spacer 25 are pressed onto the shaft 15. The second upset portion 35 is created on the opposite side of the bearing assembly 20 and the spacer 25 as the first upset portion 30. The shaft 15 complete with first and second upset portions 30, 35, the bearing assembly 20 and the spacer 25 is inserted into the motor housing 60. Thereafter, the drive washer 40 having three lugs is placed onto the shaft 15, the lugs facing away from the motor housing. The drive washer 40 is keyed to fit over the second upset portion 35 and abuts the spacer 25, which in turn abuts the inner race of the bearing assembly 20. The impeller 45 having bores to accommodate the lugs on the drive

washer 40 and keyways to accommodate the second upset  
✓ portion 35 is placed on the shaft 15. The second washer  
50 also keyed to accommodate the second upset portion 35  
is installed onto the shaft 15. After the drive washer  
5 40, the impeller 45, and the second washer 50 have been  
installed, the motor shaft extension 55 is installed into  
✓ abutment with the second washer 50.

The motor shaft extension 55 is preferably  
fabricated from aluminum and comprises first and second  
10 bores 65, 70 in either end. [The first bore 65 has a  
diameter slightly smaller than an outer diameter of the  
motor shaft 15, thereby allowing the motor shaft  
extension 55 to be pressed onto the motor shaft 15 and  
maintain an interference fit.] When installed on the  
15 motor shaft 15, the motor shaft extension 55 is in  
abutment with the second washer 50, thereby holding all  
shaft components axially against the first upset portion  
30.

The second bore 70 in the motor shaft extension  
20 55 is sized to receive and create an interference fit  
with the second impeller 62, which is disposed within a  
housing 64. The motor shaft extension 55 performs the  
function of transferring torque from the motor shaft 15  
to the impeller 62, in addition to axially retaining the  
25 motor components on the motor shaft 15. The motor shaft  
extension 55 provides a stiff shaft in situations where a  
long shaft is required. Because the motor shaft

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extension is stiff, shaft whip and wobble are eliminated. Although the motor shaft extension 55 is preferably fabricated from aluminum, it may be fabricated from steel, plastic, fiberglass or any other suitable material.

An alternate embodiment of the present invention is shown in FIG. 3. The assembly comprises a motor shaft 15, a bearing assembly 20 disposed between a first upset portion 30 and a second upset portion 35, an impeller 45, a motor housing 60, a drive spacer 80, a keyed washer 85, a tube 90, and a shaft extension 95. It should be noted that the impeller 45 may be replaced by any other suitable component.

After the first upset portion 30 is formed on the shaft 15, the bearing assembly 20 is pressed onto the shaft 15. A second upset portion 35 is created on the opposite side of the bearing assembly 20 from the first upset portion 30. The shaft 15 complete with first and second upset portions 30, 35 and the bearing assembly 20 is then inserted into the motor housing 60. Thereafter, a drive spacer 80 having three lugs is placed onto the shaft 15, the lugs facing away from the motor housing 60. The drive spacer 80 is keyed to fit over the second upset portion 35, and extends into the motor housing 60 abutting the inner race of the bearing assembly 20. The impeller 45 has bores to accommodate the lugs on the drive spacer 80 and is placed on the shaft 15. A washer

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85 also having bores to accommodate the drive spacer 80  
lugs is installed onto the shaft 15. After the drive  
spacer 80, the impeller 45, and the washer 85 have been  
installed, a tube 90 is installed into abutment with the  
5 washer 85. The tube 90 may be fabricated from aluminum,  
fiberglass, steel or any other suitable material and has  
an inner diameter slightly smaller than an outer diameter  
of the shaft 15 to form an interference fit, which holds  
the drive spacer 80, the shaft component 45, and the  
10 washer 85 in place. The installation of the tube 90 not  
only holds the shaft components in place as noted, but  
provides a receptacle into which the shaft extension 95  
may be pressed.

The shaft extension 95 may be provided to  
15 couple torque from the motor shaft 15 to another  
component such as a pump impeller (not shown), which may  
be threaded onto the shaft extension 95 and disposed  
within a housing 100. The housing 100 may be located a  
distance from the end of the motor shaft 15. The tube 98  
20 in conjunction with the shaft extension 95 provides a  
long stiff shaft, thereby eliminating shaft whip and  
wobble, and its associated noise, during motor operation.

In another alternative embodiment, such as  
shown in FIG. 4, a spacer 110 may be installed on the  
25 motor shaft 113 into abutment with the inner race of the  
bearing assembly 20. Conventional flat washers 115, 120  
are placed on either side of the impeller 45. A hex nut



125 is threaded onto the end of the motor shaft 113 to retain the washer 115, 120, the impeller 45, and the spacer 110 axially onto the shaft 113.

5 The end of motor shaft 113 is machined to receive a shaft extension 130. The shaft extension 130 is preferably machined from steel and has a hexagonal perimeter. The shaft extension 130 is preferably hardened. An aluminum fitting 135 is pressed onto an end of the shaft extension 130 that is not received by the  
10 motor shaft 113.

Typically, the shaft extension 130 is used to transfer torque from the motor shaft 113 to a driven component 145, which may be embodied in a pump impeller assembly. The driven component 145 preferably comprises  
15 a lower bearing assembly 150, which receives the aluminum fitting 135 that is pressed onto the shaft extension 130. The lower bearing assembly 150 is preferably a roller ball type assembly, which stabilizes the motor shaft extension 130 during motor operation.

20 Alternatively, the embodiment of the present invention shown in FIG. 4 may be modified as shown in FIG. 5. That is, the shaft 113, the shaft extension 130, and the fitting 135 shown in FIG. 4 may be changed. Specifically, as shown in FIG. 5, the motor shaft 160 may  
25 be machined to comprise a square compartment for receiving a first end of a square shaft extension 165, which fits loosely into the end of the motor shaft 160.

How can it rotate? Assume 15  
To Apply Pressure  
Does  
This  
work?

not shown enough detail

NO support for  
1st & 2nd  
surf & geom-  
support for  
motor shaft  
having 1st  
end with  
non-circ. x-  
section  
or even  
diff from  
surf geom  
of shaft  
120

Sub  
H1

Sub  
H2

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A fitting 170 may be pressed into a bearing assembly 150, and may receive a second end of the square shaft extension 165. The fitting 170 and the square shaft extension 165 fit together loosely to tolerate a slight misalignment between the motor shaft 160 and the driven component 145.

Preferably, the square shaft extension 165 is fabricated from flexible steel. However, alternatively, the square shaft extension may be fabricated from any other material having similar hardness and flexibility characteristics as steel. Preferably, the fitting 170 is fabricated from aluminum; however, any other suitable material may be substituted.

FIG. 6 illustrates another embodiment of the present invention, which is similar to the embodiment shown in FIG. 5. Just as in the embodiment shown in FIGS. 4 and 5, FIG. 6 includes a spacer 110, flat washers 115, 120, and a threaded shaft 113. Also included in the embodiment shown in FIG. 6 is a hex nut 170 crimped to a flexible steel shaft 180 extension to form an extension assembly 200. During installation the steel shaft 180 is fitted into the end of the motor shaft 113 and the hex nut 170 is threaded onto the motor shaft 113, thereby retaining the steel shaft 180 to the motor shaft 113.

The steel shaft 180 is slip fitted into a bearing 210 of a driven component 145. The bearing 210 preferably comprises a powdered metal bearing.

PATENT APPLICATION  
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Numerous modifications and alternative  
embodiments of the invention will be apparent to those  
skilled in the art in view of the foregoing description.  
Accordingly, this description is to be construed as  
5 illustrative only and is for the purpose of teaching  
those skilled in the art the best mode of carrying out  
the invention. The details of the structure may be  
varied substantially without departing from the spirit of  
the invention, and the exclusive use of all modifications  
10 which come within the scope of the appended claims is  
reserved.